CS800-L CLIMATRONICS
WIND SPEED AND DIRECTION SENSOR

REVISION: 10/95

WARRANTY AND ASSISTANCE

The **CS800-L CLIMATRONICS WIND SPEED AND DIRECTION SENSOR** is warranted by CAMPBELL SCIENTIFIC, INC. to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless specified otherwise. Batteries have no warranty. CAMPBELL SCIENTIFIC, INC.'s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 753-2342. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. CAMPBELL SCIENTIFIC's shipping address is:

> **CAMPBELL SCIENTIFIC, INC.**
> RMA#_____
> 815 West 1800 North
> Logan, Utah 84321-1784

CAMPBELL SCIENTIFIC, INC. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover the repair.

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FIGURES

CS800-L CLIMATRONICS
WIND SPEED AND DIRECTION SENSOR

1. GENERAL

The CS800-L sensors meet Environmental Protection Agency (EPA) Prevention of Significant Deterioration (PSD) requirements for measuring wind speed and direction. The sensors are mounted to a prewired crossarm, which mounts to 3/4" IPS (1.05 inch O.D.) vertical pipe stub. The 019ALU crossarm is required to mount the CS800-L to the UT930 10m tower as shown in Figure 1, which allows the lightning rod to be attached directly to the mast.

Wind speed is sensed by a 3-cup anemometer coupled to a light chopper that outputs a frequency proportional to wind speed. Wind direction is sensed by a wind vane coupled to a precision low-torque potentiometer. Both sensors use stainless steel precision ball bearings for maximum life and low starting thresholds.

Cable length is specified in feet, following the (-L). Specify a 34 foot lead (CS800-L34) for mounting the sensor to the UT930 10 m tower.
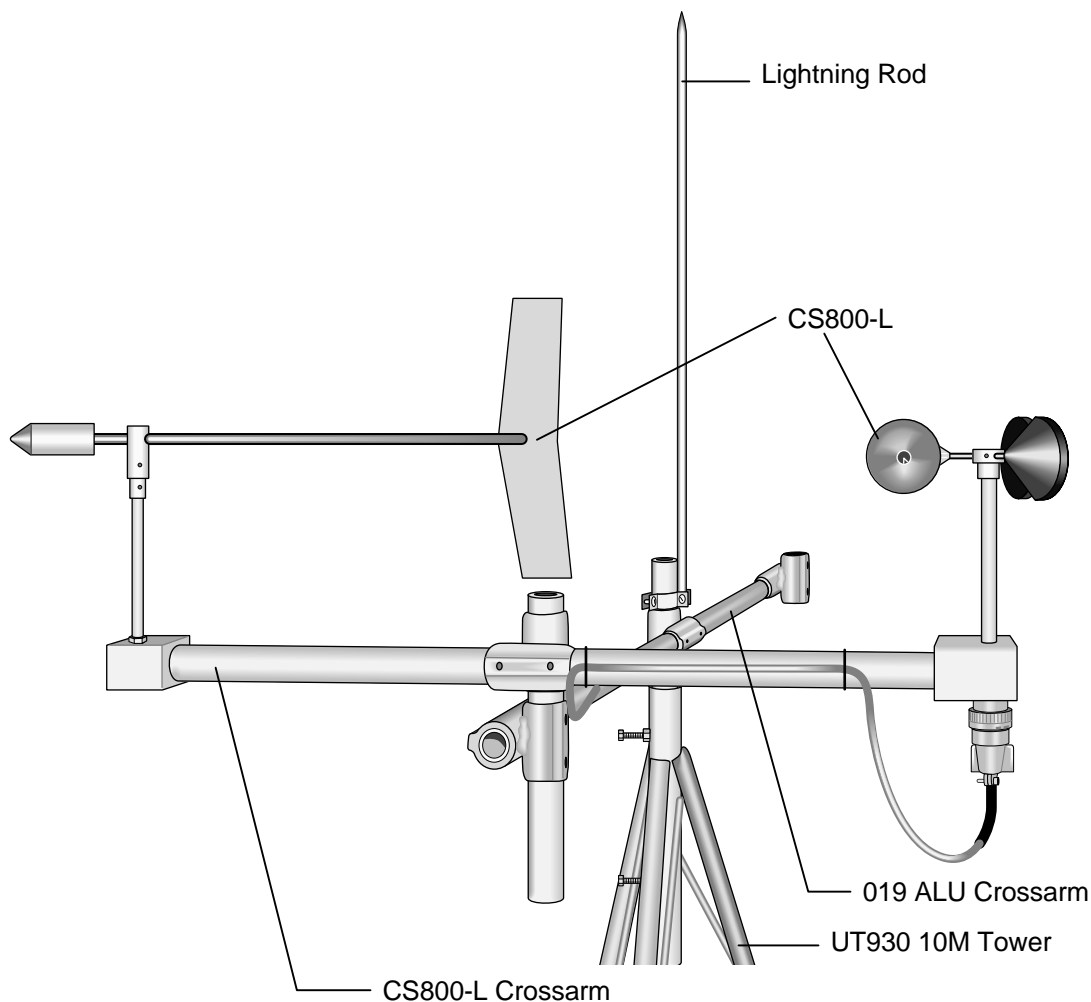

Figure 1. CS800-L Climatronics Wind Speed and Direction Sensor

2. SPECIFICATIONS

2.1 PERFORMANCE AND ELECTRICAL SPECIFICATIONS

Performance	Speed Wind	Wind Direction
Accuracy	0.25 mph or 1.5%	± 3°
Threshold	<1 mph	<1 mph
Distance Constant	8.0 ft. of air max	8.0 ft. of air max
Damping Ratio		0.4 to 0.6 at 10° displacement
Operating Range	0 - 125 mph	0 - 360° - mechanical
Signal Output	20-hole photo chopper, amplitude dependent on supply voltage; frequency proportional to wind speed:	2K ohm potentiometer 0 - excitation voltage proportional to 0 - 355°

$$\text{Freq (Hz)} = \frac{mph - 0.3}{.14388}$$

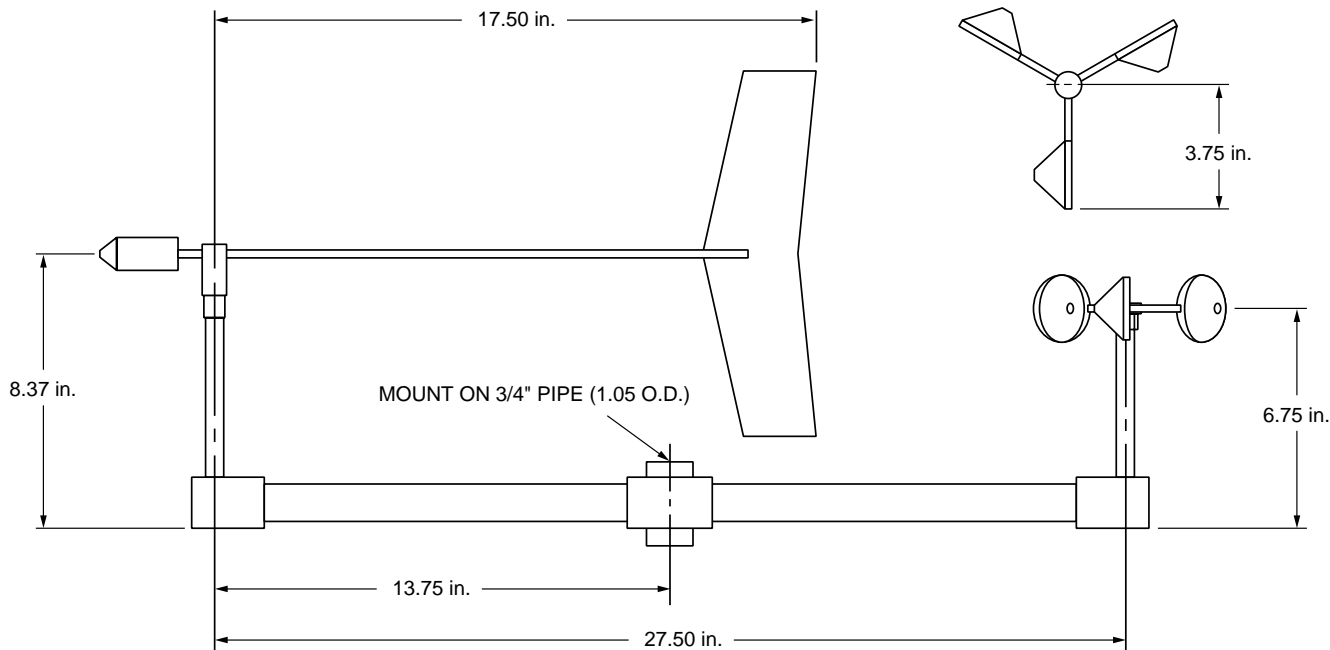|	
Temperature Range	-40 to 140 °F
Power Requirements	5-7 VDC at 1 mA nominal

2.2 PHYSICAL DIMENSIONS

Figure 2. Physical Dimensions

3. INSTALLATION

3.1 SITING

As a rule of thumb, wind sensors should be located away from obstructions (e.g., trees or buildings) by a horizontal distance of at least ten times the height of the obstruction. If it is necessary to mount the sensors on the roof of a building, the height of the sensors above the roof should be at least 1.5 times the height of the building.

3.2 SENSOR MOUNTING

Tools Required:

- 5/64" (for 019ALU crossarm) and 1/16" allen wrenches
- compass and declination angle for site
- small screwdriver provided with datalogger
- UV resistant cable ties
- small pair of diagonal-cutting pliers
- 6 - 10" torpedo level

Attach the vane and cupset to the crossarm shafts as shown in Figure 1. Place the cupset on the shaft directly above the circular connector and tighten the two set screws. Place the vane on the opposite shaft and align the flats on the vane hub and shaft as indicated. A small coin held against the flats will maintain the alignment of the flats while the two set screws are tightened.

The CS800-L crossarm mounts to the top of the UT930 tower as shown in Figure 1. Orient the 019ALU crossarm so that the end with the 3/4" NU-RAIL connector points North. Position the top of the 3/4" mounting post (provided with the sensor) 5" above the NU-RAIL and tighten the two set screws. Mount the sensor crossarm to the mounting post. Orient the sensor crossarm so that the vane end points East and tighten the set screws. Level the sensor crossarm by adjusting the NU-RAIL connector attached to the 019ALU crossarm. Refer to the UT930 Weather Station Installation Manual for a discussion on declination angle and sensor alignment to True North.

Attach the sensor cable to the crossarm connector. Make sure both connectors are properly keyed and tighten the knurled ring finger-tight. Route the sensor cable along the underside of the crossarm to the tower mast

and down a tower leg to the instrument enclosure. Secure the cable to the crossarm and mast using cable ties.

4. SENSOR WIRING

Wire the CS800-L to the datalogger as shown in Figure 3.
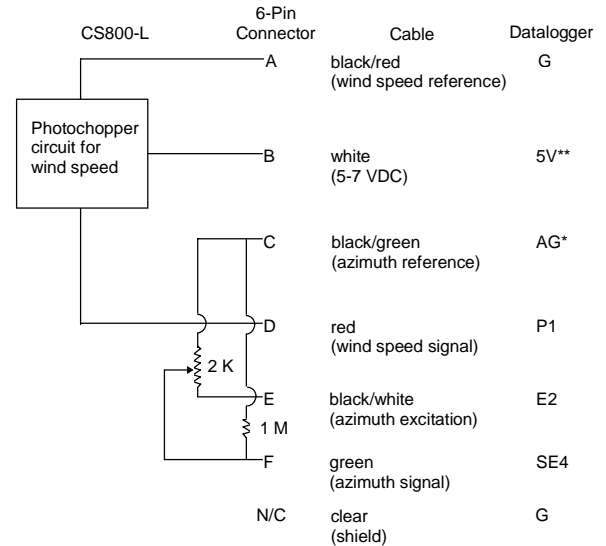
Figure 3. CS800-L Wiring

*   Ground on the 21X and CR7
** CAO port set to 5V on the 21X and CR7

The excitation, pulse and analog input channels listed above correlate with the measurement instructions shown in Section 5, and those that are used with the WeatherPro Software. The input channels and input locations are intended as examples only.

5. DATALOGGER PROGRAMMING

The output from the anemometer is a high frequency pulse that is measured with Instruction 3. Use a configuration code of 20 for parameter 3, which gives a result in frequency. The multiplier and offset converts the frequency to the desired wind speed units (see example below).

Wind direction is measured with Instruction 4. Use an excitation voltage of 2500 with the CR10, or 5000 mV with the 21X or CR7 dataloggers. The potentiometer has an electrical range of 355°, with a 5° dead band

between 355 - 360°. The multiplier to convert mV to degrees is 355 degrees / excitation voltage; which is 0.142 deg/mV for the CR10, or 0.071 deg/mV for the 21X or CR7 dataloggers (Sections 5.1, 5.2).

5.1 CR10 PROGRAMMING EXAMPLE

Wind Speed:

	P3	Pulse
01:	1	Repetitions
02:	1	Pulse Input Channel
03:	20	High Frequency; Output Hz
04:	4	Input Location [W_SPD_mph]
05:	.14388*	Multiplier
06:	.3**	Offset

Wind Direction:

	P4	Excite, Delay, Volt (Single-Ended)
01:	1	Repetitions
02:	5	2500 mV slow range
03:	4	Single-Ended Input Channel
04:	2	Excitation Channel
05:	0	Delay
06:	2500	Excitation mV
07:	5	Input Location [W_Dir_deg]
08:	.142	Multiplier
09:	0	Offset

Output Processing:

	P92	If time is
01:	0	minutes
02:	60	minute interval
03:	10	Set high Flag 0 (output)

	P77	Real Time
01:	0110	Day, Hour-Minute

	P69	Wind Vector
01:	1	Repetitions
02:	0	Samples per sub-interval
03:	00	Polar Sensor type, output avg wind speed, direction, standard deviation
04:	4	Wind speed [W_SPD_mph]
05:	5	Wind direction [W_Dir_deg]

Units (CR10/21X)	*Multiplier	**Offset
mph	.14388	.3
knots	.12494	.26052
m/sec	.06432	.1341

5.2 21X PROGRAMMING EXAMPLE

Set CAO channel 1 to 5V to power sensor:

	P30	Z=F
01:	5000	F
02:	20	Z Loc [CAO_mV]

	P21	Analog Out
01:	1	CAO Chan
02:	20	mV Loc [CAO_mV]

Measure sensors:

	P3	Pulse
01:	1	Reps
02:	1	Pulse Input Chan
03:	20	High Frequency, Output Hz
04:	3	Loc [W_SPD_mph]
05:	.14388*	Mult
06:	.3**	Offset

	P4	Excite Delay Volt (SE)
01:	1	Reps
02:	5	5000 mV Slow Range
03:	4	In Chan
04:	2	Excite all reps w/Exchan 2
05:	0	Delay (units 0.01 sec)
06:	5000	mV Excitation
07:	5	Loc [W_Dir_deg]
08:	.071	Mult
09:	0	Offset

See CR10 example for Output Processing Instructions

6. SENSOR MAINTENANCE

The CS800-L should be visually inspected every 1 - 3 months, depending on site conditions and the desired accuracy. Damaged cupsets and vanes should be replaced. Bearings in the anemometer and vane should be replaced on a periodic basis, or when measured starting torque exceeds predetermined thresholds.

A suggested maintenance schedule is as follows:

1 month:

- Visually inspect the cupwheel and vane assemblies for damage.

- Do a visual/audio inspection of the anemometer at low speeds. Make sure the cupwheel assembly rotates freely, without any wobble. Worn bearings will often produce an audible noise.

3 month:

- Measure bearing torque to determine if bearings need replacement (unless bearings are being replaced on a periodic schedule). For a 1 mph starting threshold, bearing torque should not exceed 0.28 g-cm for the anemometer, and 6.0 g-cm for the vane.

    If bearing torque is measured, starting threshold can be computed using the following equation:

    $$u = (T/K)^{1/2}$$

    where:

    u = wind speed (m/sec)
    T = torque (g-cm)
    K = is a constant for the aerodynamic shape (g)
    $\quad K = 1.4$ for the anemometer
    $\quad K = 30.0$ for the vane

12 month:

- Replace anemometer bearings.

- Check vane linearity.

24 month:

- Replace vane bearings.

Bearing replacement based on torque measurements has advantages in that: 1) the bearings are only replaced when necessary, 2) a history of bearing life is established, and 3) the starting threshold of the sensor can be determined. Torque watches for measuring bearing torque are available from the manufacturer (Climatronics 516/567-7300), for approximately $1100 (2 required).

7. TROUBLESHOOTING

7.1 WIND DIRECTION

-99999 or random negative numbers displayed in input location

   a. Make sure the battery voltage is between 9.6 and 16 VDC.

   b. Verify the sensor is wired to the Single-Ended input channel specified by parameter 3 of Instruction 4 (Single-Ended channels are numbered sequentially starting at 1H, i.e., 1L is Single-Ended channel 2).

   c. Make sure parameter 2 of Instruction 4 is 5.

0.0000 or slightly negative numbers displayed in input location

   a. Make sure the execution interval has been entered in the program table.

   b. Verify the sensor is wired to the excitation channel specified by parameter 4 of Instruction 4. Parameter 6 should be 2500 for the CR10, 5000 for the 21X/CR7.

7.2 WIND SPEED

Unreasonable results displayed in input location:

   a. Inspect the sensor for damage or contamination

   b. Check that the multiplier and offset in Instruction 3 are correct for the desired engineering units.

Offset only displayed in input location:

   a. Make sure the sensor is properly wired to the 5V and G terminals on the CR10, or to the CAO port and ground on the 21X or CR7 dataloggers. When using the CAO port, Instructions 30 and 21 should precede the sensor measurement instructions, and executed each time through the program table. Verify 5V is present on the 5V terminal or CAO port using a voltmeter.